Healthcare Analytics in Navy Medicine
Perspectives and Methods for Decision-Making

FOCUS ON POPULATION PROXIMITY

Analysis of Population Proximity and Drive-Time

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This article discusses the rising need for driving-related measures for planning and operations, historical barriers to wide-scale application of these measures, and newly available reference files available to the community of Military Health System (MHS) analysts which overcome these barriers.

Since the late 1970s the MHS has employed geographic market areas around military medical treatment facilities (MTFs) for planning and operations. The first market area concept, known as the Catchment Area, was constructed to identify the geography around military hospitals to estimate the eligible beneficiary population expected to utilize a MTF. Catchment Areas were defined as the collection of ZIP Codes whose centroids (geometric centers) were within 40 miles of a MTF, with special allowances for allocating ZIP Codes by sponsor Service affiliation when a ZIP Code was within 10 miles of more than one MTF. Exceptions to these rules, which excluded ZIP Codes in areas separated from a MTF by natural barriers (e.g., large bodies of water), were also a feature of Catchment Areas. Prior to the advent of TRICARE and enrollment, Catchment Area definitions were used by the Office of the Civilian Health and Medical Program for the Uniformed Services (OCHAMPUS) to determine whether or not a beneficiary resided in a Catchment Area, and hence was required to obtain a certificate of non-availability before OCHAMPUS would pay their purchased care claim. A certificate of non-availability was an acknowledgement by the MTF that care required by the beneficiary was not available through the MTF.

Forty years later, the MHS still uses Catchment Areas, plus there are numerous other market area concepts (e.g., PRISM, MTF Service Areas, Prime Service Areas) that support various planning and policy needs. A common attribute of these market area concepts has been the use of straight-line distance as a construction parameter in their definition. There is a noticeable absence of market area concepts containing driving distance and time which are more sensitive to analyzing beneficiary proximity to health services and that align with TRICARE access standards.[1,2]

The Need for Drive-Time Methods

Maximizing health network resources to meet the needs of a subscriber population requires an understanding of the proximity of network resources to the intended population being served.

Historically this has been analyzed using straight-line distances rather than the more relevant drive-time, largely due to the ease of calculating distances versus the difficult and time consuming process to compute more relevant travel-time measures. As geospatial software applications have matured and become more mainstream over the last decade, many health care organizations are switching from straight-line distance to drive-time based methods to manage and evaluate the adequacy of their health care networks.

Two of the largest Federal health care organizations, the

1 ASD(HA) Policy Memorandum 11-005, TRICARE Policy for Access to Care, February 23, 2011.

2 Access is multi-dimensional and includes more than drive-time considerations. A full discussion of MHS access standards can be found in Volume 5, Issue 3 (Access to Care) of this publication.

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MHS and the Veterans Health Administration (VHA), have adopted drive-time standards to evaluate how well their health networks are serving their beneficiaries. While these and other health care organizations are looking to drive-time measures to better manage their systems, they face significant barriers to incorporating drive-time factors in day-to-day planning, evaluation, and management. Geospatial software required for drive-time analyses is generally expensive, requires significant investments in user training, requires sensitive beneficiary/patient record-level inputs, and is optimally designed to work best for relatively small geographic areas (e.g., individual metropolitan/market areas). It is cumbersome, if not impossible, to use for regional or nationwide analyses.

Using Drive-Time Reference Files

BUMED is sponsoring the development/release of two reference files that provide MHS analysts a means to conduct driving-related market analyses and circumvent these barriers. More details on these files and how to access them are described in the *Data and Information Systems* section of this newsletter and summarized below.

The first reference file was developed for BUMED and is a modified and enhanced MTF Service Area Catchment Area Directory (CAD). Using geospatial software, road network datasets, and information on traffic congestion factors, driving distance and time between ZIP Codes and MTFs were computed and added to a traditional CAD-like file containing straight-line distance. This enhanced CAD file, in conjunction with data from central systems such the MHS Data Repository (MDR) and MHS Mart (M2), can be used to answer a host of management questions. For example, initiatives exploring the potential for recapturing network enrollees can use the enhanced CAD to estimate how many network enrollees are within a 30-minute drive of a direct care enrollment site. Another use might be to quantify the percentage of direct care enrollees within and outside the prescribed 30-minute standard for primary care. As the enhanced MTF Service Area CAD contains drive-times and distances from ZIP Code centroids to MTF enrollment sites only, it will not support answering questions concerning travel times to network providers or proximity-related questions such as where to site a new clinic to reach the most beneficiaries within a given driving time or distance. This file has been released and is available for download from the BUMED Analytics SharePoint site (https://esportal.med.navy.mil/bumed/m8/m81/analytics2/).

The second reference file, the MHS-Beneficiary National ZIP Code Drive-Time Dataset (MHS-BNZCDTD), will support proximity-related analyses between any ZIP Codes that are within 150 miles of each other. Using the beneficiary population-weighted centroid of the ZIP Code of the beneficiary and the ZIP Code of the provider, questions that could not be answered with the enhanced MTF Service Area CAD can be answered with the MHS-BNZCDTD. For example, the MHS-BNZCDTD will help quantify how far direct care enrollees referred for specialty care are traveling to receive services and how well the provider network is complying with travel access standards. The MHS-BNZCDTD will also provide the data needed to perform proximity analysis, a method of quantifying cumulative statistics (e.g., beneficiary populations) within a specified drive-time (or distance) of some geography (e.g., ZIP Code). Proximity analysis is an approach often used to help determine site alternatives for locating new facilities or services. For example, it has been used for many years in commercial retail to select locations for new stores or outlets by identifying those geographic locations that have the greatest number of households or population with desired demographics within a certain drive-time or radius. An application of proximity analysis in the MHS might be to help determined the best candidate location to locate a remote clinic. For example, if a MTF were interested in recapturing obstetrical care going to the network, they may consider an option to staff a clinic certain days of the week that is off-site from the MTF to shorten the drive for expectant mothers to prenatal visits. Using the MHS-BNZCDTD and data from M2, the number of women of childbearing age within varying driving times (e.g., 5, 10, 15 minutes) of ZIP Codes proximate to the MTF could be computed to identify candidate locations for a clinic that would reach the greatest number of women within reasonable drive-times.

Data sources and methods supporting drive-time analysis provide further understanding of population proximity in relation to health care resources so that the needs of the beneficiary population are better served. This heightened understanding supports efficient planning, better management of limited resources, improved access, and targeted population interventions and services.

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TO LEARN MORE...

More information related to the some of these topics has been presented in BUMED-sponsored webinars, "The Changing Shape of MHS Catchment Areas", presented as part of the Populations and Health Care Systems Performance webinar series, and "Using Geospatial Analysis to Assess Access to Care", presented as part of the Quality, Safety, and Access webinar series. Slides and recordings from these webinars are available on the BUMED Analytics SharePoint site (https://esportal.med.navy.mil/bumed/m8/m81/analytics2/). Additionally, a BUMED-sponsored half-day long Foundations course has been developed. The course provides training on aspects of catchment/market areas and details on how to use the reference files of the type discussed in this article for analyzing MHS issues.

SKILLS AND METHODS

— POPULATION CONCEPTS IN MHS DATA

There are many different population concepts available in MHS data sources, and choosing the "right" concept for your question can sometimes be challenging. All the population concepts discussed in this section are available in MHS Data Repository (MDR) files and MHS Mart (M2) data tables.

For all population concepts, beneficiaries can only be assigned to the market area of one MTF. Beneficiaries who live near more than one MTF are allocated based on their sponsor service and distance to the MTF. In these overlapping areas, beneficiaries are assigned to the closest MTF of their own service unless there is an MTF more than 10 miles closer. As of January 2015, there are 59 inpatient Catchment Areas and 287 PRISM Areas/MTF Service Areas. Of the 59 inpatient Catchment Areas, 20 surround Navy facilities. Among the 287 PRISM/MTF Service Areas, there are 113 Navy facilities.

Catchment Area

A Catchment Area is defined as the market area that represents roughly a 40-mile radius around a bedded inpatient facility. The beneficiary population of a Catchment Area is comprised of those eligibles residing within 40 miles of the MTF, or in the case of active duty military members, it is based on the distance from the MTF to the individual's duty location. Beneficiaries residing more than 40 miles from a bedded inpatient facility are assigned a Catchment Area DMIS ID of 09XX or 078X—these codes typically designate a state, part of a state, or county and are considered "non-Catchment".

Although Catchment Areas are associated with individual branches of Service, non-Catchment Areas do not discriminate in this way. When a quantification of the eligible population associated with a particular branch of Service is desired, this is usually done by summing the population counts for the Catchment Areas associated with that branch of Service and the portions of the population in the non-Catchment Areas that have a sponsor associated with that branch of Service. For the Navy, this would be the population of eligibles for all Navy Catchment Areas, plus the population of eligibles in non-Catchment Areas that have a sponsor associated with either the Navy or Marine Corps.

PRISM Area

A PRISM (Provider Requirement Integrated Specialty Model) Area is defined as the market area that represents roughly a 20-mile radius around a stand-alone MTF—both inpatient and ambulatory-only facilities. When evaluating data by PRISM Area, analysts are most interested in what is going on closest to the specified MTF. All beneficiaries residing more than 20 miles from a PRISM Area will be identified as living in a non-PRISM Area (with 09XX or 078X DMIS IDs). It should also be noted that the entirety of a PRISM Area may exist totally within a Catchment Area, within a non-Catchment Area, or straddle the two.

MTF Service Area

An MTF Service Area is similar to both Catchment and PRISM Areas. It is similar to Catchment Area, because the geographic radius used is 40 miles; but applies to both inpatient and ambulatory MTFs are included. This concept allows users to compare data at all sites using the same 40-mile radius around a facility.

Difference between Catchment Area and MTF Service Area

While conceptually similar, an MTF Service Area and a Catchment Area will not always represent the same area for inpatient MTFs. The reason for this is that when

determining Catchment Areas, only inpatient facilities are considered. When determining MTF Service Areas, beneficiaries that live in overlapping MTF Service Areas are disbursed among both inpatient and ambulatory MTFs in the overlap based on sponsor Service and distance to the MTF. For example, the Fort Stewart Catchment Area has roughly 90,000 beneficiaries assigned to it. However, the Fort Stewart MTF Service Area is much smaller, with only about 56,000 beneficiaries. This is because Fort Stewart is the only inpatient MTF in the area, so that the Catchment Area gets the entire population. But when the MTF Service Area concept is invoked, the two clinics surrounding Fort Stewart are considered when determining overlap areas, and consequently, a large portion of Fort Stewart's Catchment Area residents are actually residents of a different MTF Service Area.

Multi-Service Market Area

Multi-service Market Areas (MSMA) are 14 areas that have overlapping Catchment Areas or geographic areas where multiple MTFs are in relatively close proximity. MSMAs are helpful in identifying larger areas where patients have many choices of MTFs, even across Service lines. Approximately 60 percent of beneficiaries that live in Navy Catchment Areas part of a MSMA.

The 14 MSMAs are: National Capital Region; Tidewater, VA; Fort Bragg, NC; Naval Hospital Charleston/Charleston AFB, NC; Ft. Jackson/Shaw AFB, SC; Mississippi Delta; San Antonio, TX; Colorado Springs, CO; San Diego, CA; Puget Sound, WA; Hawaii; Anchorage, AK; Fairbanks, AK; and Naval Hospital Jacksonville, FL.

Enhanced Multi-Service Markets

Enhanced Multi-Service Markets (eMSMs) are six large multi-service markets and geographic areas with integrated health care delivery and operations. These markets are provided with "enhanced" authorities that include the authority to manage the allocation of the budget for the market, direct the adoption of common clinical and business functions for the market, optimize readiness to deploy medically-ready forces and ready medical forces, and direct the movement of workload and workforce between or among the MTFs. eMSM operations became effective October 1, 2013.

The six eMSMs include: National Capital Region (Lead: Defense Health Agency); Tidewater, Virginia VA (Lead: Navy); Colorado Springs, CO (Lead: Air Force/Army rotation); San Antonio, TX (Lead: Air Force/Army rotation); Puget Sound, WA (Lead: Army); and Oahu, HI (Lead: Army).

Gold Standard Catchment Area

One limitation of all of the market concepts described above is that the distance from an MTF to a particular ZIP code has been historically defined based on the geographic center of the beneficiary ZIP code, instead of where the military population actually lives. In areas near large cities, the effect can be dramatic. Navy escapes the effect, for the most part; however, some MTFs are affected. For example, 2,500 beneficiaries assigned to the Pensacola Catchment Area are really thought to live closer to Eglin AFB than to Pensacola. The gold standard Catchment Area is assigned based on where the military population actually resides. The gold standard Catchment Area is available in M2 data tables as the "Catchment Area ID of record".

Enrollment

An important consideration when using market constructs to determine populations for MTF health care services is to note that the beneficiary's choice of enrollment location is not part of the calculation. Beneficiaries make choices about where to enroll, while the Catchment, PRISM and MTF Service Area allocations do not take that choice into consideration. When trying to determine which beneficiaries might utilize health care, it is best to assume that if a beneficiary chose an enrollment location, the choice was made based on where the beneficiary expects to seek care. Therefore, it is recommended that for enrolled populations, it should be assumed that the beneficiaries who enroll at an MTF are likely to receive care at that MTF. For non-enrolled populations, Catchment Areas and other similar market designations work well.

Population Areas Used in the TRICARE Contracts

MHS data sources also contain some market concepts that are applicable to the management and operations of the TRICARE contracts. Prime Service Area (PSA) is a geographic area where TRICARE Prime benefits are offered. Regional contractors are required to establish a TRICARE Prime network in TRICARE PSAs. This includes all Catchment Areas, Base Realignment and Closure sites, MTF Service Areas, and all additional areas proposed by the regional contractors. A PSA flag is available in many M2 data tables indicating whether or not a beneficiary resides in a PSA. Market Area IDs are also available in many M2 data tables and are defined and used by the TRICARE Regional Offices to manage local

TRICARE efforts.

DATA AND INFORMATION SYSTEMS

— *REFERENCE FILES SUPPORTING DRIVE-TIME ANALYSES*

Navy BUMED is sponsoring the development/release of two reference files to provide MHS analysts a means to conduct drive-time related analyses. One reference file, available now, is a modified and enhanced MTF Service Area Catchment Area Directory (CAD) containing driving distance and time (in addition to the traditional straight-line distance) from ZIP Code centroids to MTF enrollment sites. The second reference file, the MHS Beneficiary National ZIP Code Drive-Time Dataset (MHS-BNZCDTD), contains driving distance and time, as well as straight-line distance, from DoD beneficiary centroids to ZIP Code centroids for all ZIP Code pairs in the U.S. whose centroids are within 150 miles of each other. This file is under development and is scheduled for release in April 2016. Brief descriptions of the creation and contents of these files are provided below.

Enhanced MTF Service Area CAD

The enhanced MTF Service Area CAD reference file was created for Navy BUMED using ESRI ArcGIS Desktop software and data from a host of DHA, commercial, and educational institution sources. Data inputs included the April 2015 MTF Service Area CAD (for the list of 231 MTF enrollment sites), the March 2015 DHA Decision Support Routing file (for latitudes and longitudes for the 231 MTFs), the Texas A&M Transportation Institute's 2012 Urban Mobility Study (for travel time congestion factors), and the April 2015 ZIPList 5™ from ZipInfo (for latitudes and longitudes of ZIP Code centroids). ESRI ArcGIS Desktop v10.3 software and geoprocessing tools were used to calculate distances between ZIP Code centroids and MTF enrollment sites. StreetMap Premium Mobile Dataset (2012) was used for the Road Network input to provide routing information between ZIP Code centroids and MTF enrollment sites. ESRI Network Analyst extension (v10.3) was used to calculate drive-times and drive-distances. Note, for 10 records, ESRI products did not produce a routing solution from ZIP Code to MTF. Google was used for these records as noted in the "Drive-time_Override_Source" field. The eMTF Service Area CAD is in an Excel spreadsheet format. This reference file resides on the BUMED Analytics SharePoint site (https://esportal.med.navy.mil/bumed/m8/m81/analytics2/) and contains 50,544 records.

Table 1. Variables in the Enhanced MTF Service Area Catchment Area Directory (CAD)

Field Name	Description
ObjectID	ObjectID is a unique, not null integer field used to uniquely identify rows.
From_ZIP_Code	The ZIP Code from which drive time and distance calculations to a MTF originated from.
To_DMISID	The DMISID of the MTF to which drive time and distances calculation were computed.
To_DMISID_NAME	Name of MTF associated with "To_DMISID".
Straightline_Distance	Straightline distance in miles from the ZIP Code centroid to the latitude/longitude of the MTF.
Drive_Distance	Drive distance in miles from the ZIP Code centroid to the latitude/longitude of the MTF.
Uncongested_Drive_Time	Uncongested drive time in minutes from the ZIP Code centroid to the latitude/longitude of the MTF.
Congested_Drive-Time_Small_Metro_Area	Congested driving-time in minutes for the average small metropolitan area (defined as having a population size less than 500,000). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.11 to approximate the effect of traffic congestion on average trip duration.
Congested Drive-Time_Medium_Metro_Area	Congested driving-time in minutes for the average medium sized metropolitan area (defined as having a population size between 500,000 and less than 1 million). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.15 to approximate the effect of traffic congestion on average trip duration.
Congested_Drive-Time_Large_Metro_Area	Congested driving-time in minutes for the average large sized metropolitan area (defined as having a population size between 1 million and less than 3 million). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.20 to approximate the effect of traffic congestion on average trip duration.
Congested_Drive-Time_Very_Large_Metro_Area	Congested driving-time in minutes for the average very large sized metropolitan area (defined as having a population size of 3 million or more). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.27 to approximate the effect of traffic congestion on average trip duration.
Drive-Time_Override_Source	The data source that was used to calculate drive distance and drive time in instances where Esri Network Analyst could not calculate the route.

Table 1 describes the variables in this file.

MHS Beneficiary National ZIP Code Drive-Time Dataset (MHS-BNZCDTD)

The MHS-BNZCDTD reference file is under development by Altarum Institute for delivery to BUMED in April 2016. It will contain a database of computed driving times and distances between MHS beneficiary population-weighted centroids of all ZIP Codes to all other ZIP Codes whose MHS beneficiary population-weighted centroids are within 150 miles of each other. Drive-times will be calculated as the driving-time between the latitude and longitude of MHS beneficiary ZIP Code population weighted centroids assigned to the closest navigational road segment using ESRI Data and Maps for ArcGIS v10.3.1, Network Analyst, and StreetMap Premium Mobile Dataset (2012). ZIP Code population weighted centroids will be computed from MHS beneficiary population geocoded street address data using ESRI's geometric mean weighting function. From past experience, it is expected that the full U.S. level dataset will contain roughly 70 million ZIP Code pairs and be more than 2 gigabytes in size when compressed. For manageability, 50 state-level datasets, the District of Columbia, Puerto Rico, and a combined Maryland/Virginia dataset will be created from the U.S. level dataset. These datasets contain not only the respective ZIP Codes in their state/geographic borders; they contain ZIP Codes from neighboring states if they are within 150 miles of a ZIP Code in the state/geographic area. For example, the state dataset for Michigan contains ZIP Codes from Ohio, Indiana, Illinois, Wisconsin, and Minnesota that are with 150 miles of a Michigan ZIP Code. Datasets will reside on the BUMED Analytics SharePoint site https://esportal.med.navy.mil/bumed/m8/m81/analytics2/), size permitting. Other delivery solutions will be explored if size precludes using the SharePoint site as a delivery mechanism. The MHS-BNZCDTD will contain variables described in

Table 2. Variables in the MHS-BNZCDTD

Field Name	Description
ObjectID	ObjectID is a unique, not null integer field used to uniquely identify rows.
From_ZIP_Code	The ZIP Code from which drive time and distance calculations to a MTF originated from.
From_State_Abbreviation	The state abbreviation associated with the "From_ZIP_Code".
To_ZIP Code	The ZIP Code to which drive times and distances are calculated for respective "From_ZIP_Code".
To_State_Abbreviation	The state abbreviation associated with the "To_ZIP_Code".
Straightline_Distance	Straightline distance in miles from the ZIP Code centroid to the latitude/longitude of the MTF.
Drive_Distance	Drive distance in miles from the ZIP Code centroid to the latitude/longitude of the MTF.
Uncongested_Drive_Time	Uncongested drive time in minutes from the ZIP Code centroid to the latitude/longitude of the MTF.
Congested_Drive-Time_Small_Metro_Area	Congested driving-time in minutes for the average small metropolitan area (defined as having a population size less than 500,000). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.11 to approximate the effect of traffic congestion on average trip duration.
Congested Drive-Time_Medium_Metro_Area	Congested driving-time in minutes for the average medium sized metropolitan area (defined as having a population size between 500,000 and less than 1 million). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.15 to approximate the effect of traffic congestion on average trip duration.
Congested_Drive-Time_Large_Metro_Area	Congested driving-time in minutes for the average large sized metropolitan area (defined as having a population size between 1 million and less than 3 million). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.20 to approximate the effect of traffic congestion on average trip duration.
Congested_Drive-Time_Very_Large_Metro_Area	Congested driving-time in minutes for the average very large sized metropolitan area (defined as having a population size of 3 million or more). Computed by multiplying "Uncongested_Drive_Time" by a congestion index of 1.27 to approximate the effect of traffic congestion on average trip duration.

Table 2.

NEW KNOWLEDGE

– NOTED PUBLICATIONS

This recent article provides an example of using population proximity to a health facility to assess utilization of a health care product line.

Emergency department visits and proximity to patients' residences, 2009–2010

Brown AM, Decker SL, and Selck FW. NCHS Data Brief #192. 2015 March.

The analysis described in this article sought to understand the circumstances in which patients visit an emergency department (ED) other than the one closest to their home. The analysis uses geographic information about the location of EDs throughout the United States in conjunction with information about the location of patient residences to assess: a) whether visits take place at the ED closest to where patients live, and b) which factors are associated with where these visits occurred.

Results suggest that ED visit patterns vary considerably by whether or not patients live in a metropolitan statistical area (MSA) – geographic entities that have a population of over 50,000. Outside of MSAs, the majority of visits take place at the ED closest to a patient's home, while within MSAs, several factors are associated with patients bypassing the closest ED and visiting an ED farther away. In 2009–2010, visits to an ED farther than the closest one were more likely to occur among patients younger than age 65 and at hospitals with a higher visit volume. Visits within MSAs were more likely than visits outside of MSAs to occur at an ED farther than the closest one, despite the fact that EDs closest to a patient's home had lower average wait-times for seeing a clinician.

The full article can be downloaded at http://www.cdc.gov/nchs/data/databriefs/db192.pdf.

TIPS AND TRICKS

— UNDERSTANDING GIS

For analysts interested in the use and application of Geographic Information Systems (GIS) to analyze health delivery and organization, several online resources are available to provide an introduction to GIS. This section highlights selected government agency resources currently available online.

TIP - UNDERSTANDING GIS

Centers for Disease Control and Prevention (CDC)

CDC has long used GIS to integrate geographical information and health data to promote and protect health. The website "GIS at CDC" provides links to data sources, training resources, map galleries, and several web applications. Specifically, this website includes:

- What is GIS?
- Training
- Data
- Applications
- Map Gallery
- Other Resources (links to newsletters and listserv groups)

Visit the website at http://www.cdc.gov/gis/.

TIP - UNDERSTANDING GIS

National Cancer Institute (NCI)

NCI conducts GIS-related activities and initiatives to support cancer control and population-based cancer research. The "Geographic Information Systems and Science" website is supported by the NCI as a central source of information about GIS and related resources for use by the public, cancer researchers, and the GIS Special Interest Group. Specifically, this website includes:

- An introduction to GIS at NCI
- Portal for interactive web-based mapping tools and services
- Publications and research from institutions using GIS technology
- Tools and data service to assist in analysis and visualization

Visit the website at http://gis.cancer.gov/.

Pan-American World Health Organization

The Pan-American World Health Organization's Health Analysis and Information Systems Area's (AIS) project on Geographic Information Systems in Health (GIS-EPI) was created with the objective to contribute to the strengthening of health workers' capacity for epidemiological analysis by providing efficient tools with GIS-Epi to facilitate such tasks. The website includes:

- Applications
- Databases
- Software
- Training
- Dissemination
- Collaboration

Visit the GIS-EPI website at http://ais.paho.org/sigepi/index.asp?lang=en.

Other Resources

Additionally, a comprehensive online resource for GIS application to public health is maintained by the University of California Berkley Public Health Library. This website organizes resources by organizations and agencies; publications, databases, and applications; and guides. This resource can be accessed http://www.lib.berkeley.edu/PUBL/gis.html.

KNOWLEDGE SOURCES

— PUBLICATIONS

The following publications are recommended reading for those who wish to broaden their capabilities by acquiring a foundational understanding of current topics and issues in health geography.

International Journal of Health Geographics

International Journal of Health Geographics is an open access, peer-reviewed, online journal fully dedicated to publishing quality manuscripts on all aspects of geospatial information systems and science applications in health and health care. The *International Journal of Health Geographics* aims to cover a wide range of interdisciplinary geospatial topics in a health/health care context, from spatial data infrastructure and Web geospatial interoperability research, to research into real-time Geographic Information Systems (GIS)-enabled surveillance services, remote sensing applications, spatial epidemiology, spatio-temporal statistics, and even cyberspace mapping. More information about this publication can be found at http://www.ij-healthgeographics.com/.

Health and Place

Health and Place is an interdisciplinary journal dedicated to the study of all aspects of health and health care in which place or location matters. The journal includes research that explores the evolving links between medical geography, medical sociology, health policy, public health and epidemiology. Journal articles reflect these convergences, which emphasize differences in health and health care between places, the experience of health and care in specific places, the development of health care for places, and the methodologies and theories underpinning the study of these issues. More information about this publication can be found at http://www.journals.elsevier.com/health-and-place.

IN THE NEXT ISSUE

The next issue of *Healthcare Analytics in Navy Medicine* will focus on surgical operations. This issue will provide an overview of work done to identify and standardize key metrics for surgical access, readiness, and efficiency. Moreover, multiple data points to consider when monitoring surgical operations are discussed, as well as a newly developed operating room dashboard tool and the metrics currently tracked using this tool.

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